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ORIGINAL LECTURES.

ANTISEPTICS;
HOW USED AND HOW MADE AT THE
NEW YORK HOSPITAL.

A Clinical Lecture.

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In beginning my annual course of clinical lectures I wish briefly to place before you in a practical way how antiseptic dressings are made and used in this hospital. I have little or nothing new to present to you concerning the great truths upon which the antiseptic treatment is based. It is known to you all that we are continually surrounded by germs of many varieties. Miquel has found, for instance, that the ordinary atmosphere of a large city contains over 2000 bacteria per cubic yard, while the air of a room of an old house in winter will show bacteria to the amount of 45,000 per cubic yard, and again that the wards of a long-used hospital will hold as many as 90,000 germs in the same space. This same observer has shown, and others have confirmed it, that sea air contains scarcely any of these micro-organisms, and that mountain heights are as nearly free from them for obvious reasons; also that there are more of them to be encountered in our houses and hospitals in winter than in the spring time and in summer.

But all these microorganisms are not infectious, or, speaking more strictly to what chiefly interests us, are not capable of begetting inflammation and suppuration. Only relatively few of them can do this. I will not stop to enumerate even this short list of infectious germs. I shall only dwell upon the two facts, that one of them, the so-called *staphylococcus pyogenes*, is the factor in producing suppuration in the large majority of instances. Reliable authorities say that they exist in seven-eighths of the cases, and that no formation of pus can be brought about clinically or experimentally save by the aid of such or similar organisms, or by the ptomaines or juices that they create. With these facts at hand you can easily grasp the subject of antisepsis.

There is perhaps one other point that can here be appropriately placed before you; it is that the living tissues of the body have a certain power of resistance to the evil influence of germs, and it requires, according to the Scotch observer Cheyne, an appreciable amount of infectious germs to make an inroad upon the system. This explains why we are not all destroyed whenever a scratch occurs on the finger, etc.

From the foregoing remarks you can readily see that the destruction of infectious germs or the hindering of their natural multiplication is the end of our antiseptic treatment. Lister's dictum, that you should act as if you saw germs lighting on every wound you have to do with, leads to a correct treatment. You should try to

kill them as you would a flea, and you have a better chance with the germ than you have with the insect. Cleanliness alone will not do this—wash your hands as you will, your ordinary instruments, or your sponges with soap and with water, and yet in testing all these with the well-known culture tests, colonies of bacteria will be developed, this KÜMMEL¹ has fully proven. Cleanliness, personal and otherwise, is of great moment, and it will make a vast improvement in your surgery; but unless you conjoin with it large experience and marvellous skill, you will hardly equal the tyro who adds to cleanliness the use of antiseptic measures. Look for a moment at this table, which shows you at a glance the impression antisepsis has made upon the surgical world. Here are the names² of the masters of the surgical art acquiescing in using the principles just set before you. Their opponents who are worthy of such a rank, if named could be counted on the fingers of one hand.

TABLE I.

No.	Surgeon.	Locality.	Antiseptics.
1	Mitchell Banks,	Liverpool,	Sublimate and carbolic spray.
2	Whitehead,	Manchester,	Carbolic spray.
3	Macewen,	Glasgow,	Strict antisepsis.
4	Ogston,	Aberdeen,	Carbolic acid.
5	Keith,	Edinburgh,	Carbolic acid, except in spray.
6	Annandale,	Edinburg	Sublimate dressings.
7	Péan,	Paris,	" "
8	Lücke,	Strassburg,	" "
9	Koeberlé,	Strassburg,	Alcohol flame, carbolic acid, and boiled artificial sponges
10	Czerny,	Heidelberg,	Sublimate.
11	König,	Göttingen,	Sublimate and iodoform.
12	Volkmann,	Halle,	" " "
13	Gussenbauer,	Prague,	Sublimate.
14	Nussbaum,	Munich,	" "
15	Winkel,	Munich,	" "
16	Krönlein,	Zurich,	" "
17	Kocher,	Berne,	" "
18	Billroth,	Vienna,	Sublimate and iodoform.
19	Albert,	Vienna,	" " "
20	Julliard,	Geneva,	Carbolic acid.
21	Terrier,	Paris,	Sublimate and carbolic acid.
22	Championnière,	Paris,	" " " "
23	Bergmann,	Berlin,	Heat, sublimate, and iodoform.
24	Hahn	Berlin,	Sublimate and iodoform.
25	Esmarch,	Kiel,	" " " "
26	Schede,	Hamburg,	Sublimate.

A considerable variety of antiseptics are in vogue, and every little while a new one appears which is claimed to possess advantages over its predecessors, but the trials made in the operating-room and in the laboratory show, so far, that carbolic acid and corrosive sublimate

¹ KÜMMEL: Die Kontakt- und Luft-infection in der praktischen Chirurgie, Centralbl. f. Chirurg., 1885. Beilage 326.

² From Senn, Four Months Among the Surgeons of Europe, and other sources.



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lead, like Ben Adhem's name, all the rest. I have taken pains heretofore to present to you a list of germicides taken from the works of Koch and Sternberg, to show you their relative values, but to-day I can give you, through the kindness of Dr. Weeks¹, of this city, who has kindly placed his advanced proofs at my service, another list, which embraces not only his own bacteriological investigations, but those of other observers. These you will see in Table II.

TABLE II.

(From the investigations of Dr. Weeks, of New York.)

Antiseptic.	Strength.	Duration of exposure to destroy vitality of germs.
1. Corrosive sublimate,	1 to 500	10 seconds.
" "	1 to 1000	45 "
" "	1 to 2000	1½ minutes.
" "	1 to 5000	3 "
" "	1 to 10,000	5 "
" "	1 to 20,000	12-15 "
2. Biniodide of mercury (very insoluble).	1 to 40,000	4 days.
3. Nitrate of silver,	1 to 10	4 seconds.
" "	1 to 50	8 "
" "	1 to 100	12 "
" "	1 to 500	1½ minutes.
4. Carbolic acid,	1 to 20	15 seconds
" "	1 to 40	30-60 "
" "	1 to 60	4 minutes.
5. Alcohol,		No effect on dried germs; very powerful when active in moistened condition.
"		absolute alcohol, 4-12 seconds.
"		95 per cent. " 20-30 "
"		66 per cent. " 10-15 minutes.
6. Salicylic acid, (makes a stable solution).	600 parts of water.	
" "	1 to 600	1 minute.
" "	1 to 1000	4-5 "
7. Permanganate of potash, makes an unstable solution in 16 parts water.		
" "	1 to 50	20 seconds.
" "	1 to 100	1 minute.
" "	1 to 200	5 "
8. Chlorine water, very unstable, best when fresh, 1½ min.		
9. Hydrogen bromide, " " " " 1-1½ "		
10. Boric acid had no germicidal action whatever; germs remained unaffected for 10 days.		
11. Iodine to saturation in water did not affect germs after 48 hours' exposure.		
12. Chloride of zinc, 1 to 20 in water, had no effect.		
13. Oil of turpentine,	" "	
14. Thymol,	" "	
15. Eucalyptol,	" "	
16. Ointments of 10 per cent. of iodoform and of iodol of the same strength had no effect after 36 hours' exposure.		
17. Iodoform in powder only retarded development of germs after 12 hours' exposure.		
18. Iodol, bismuth subnitrate, and boric acid in powder exerted no effect.		
19. Boiling water, and in fact heat from 165.2° to 212° F., destroyed germ life on contact.		

Whoever among you that has kept abreast with the current literature will not be surprised at two things met with in the list. First, that the fact taught us several

years since by Koch, has been confirmed by Dr. Weeks, that oily solutions or mixtures, of the various antiseptics have no value other than is slowly exerted by the fatty matters themselves; and, second, that iodoform, concerning the power of which in germs much has lately been written, exerts its germicide action but slowly. On this point of the value of iodoform in controlling inflammation—ordinary and tuberculous—I may say that the clinical experience of surgeons is in favor of its usefulness, and is decidedly opposed to the laboratory deductions. The discussion of this subject, however, has developed the fact that this substance in dry powder often contains germs, and that it works best when acted upon and changed by wound secretions. Practically, it is nearly always used here in a dampened condition in conjunction with the moist sublimate gauze, and in this combination it is leaned on heavily as a supporter of antisepsis.

To the list of chemical germicides must be added one other which possesses advantages beyond these in safety, cheapness, and accessibility. I refer to the action of heat. A temperature of boiling water will destroy the life of surgical germs, though in some varieties a greater heat is necessary to kill the life of the more resisting spores. Freshly boiled water cooled in covered vessels or by the admixture of water boiled and cooled the same day is coming here more and more into use for the purposes of washing or irrigating wounds, and in Germany the dressings are also sterilized before each operation by heat and used without any medicated impregnation.

If you watch the preparations and the antiseptic technique of this amputation of the forearm, which will be now performed by the House Surgeon, you will gather the main points of the antiseptic treatment of a wound. You will notice first that the instruments, which are either made, handles and all, of one piece of steel, or that the handles are of hard rubber baked on so as to leave no crevices,¹ are, with the needles, scrubbed with green soft soap and water and placed in boiling water for ten minutes, and then into carbolic acid water, 1 part to 20, for at least the same time. The ordinary yellow soap contains germs in abundance according to Eiselsberg, but it can be used if previously soaked for half an hour in 1:1000 sublimate solution. All the sponges which have been cleansed by Keller's² method, or by washing

¹ Some excellent ones are now made in Germany by heavily electroplating over wooden handles. This obviates the too great weight of metal handles.

² In this method the new sponges, after having been rid of the sand by shaking and beating them, are thoroughly washed in warm—not hot—water, for if hot water is used it deteriorates the quality of the sponge substance, and tends to fix the drift within its meshes. This is particularly so if the sponges have already been used at an operation. The sponge is then placed in a 1 to 1000 solution of permanganate of potash for twenty-four hours. If the permanganate is found to be losing its beautiful pink color, a little more may be added. At the end of this time the permanganate of potash is washed out with warm water. The sponges are now bleached by immersion in a solution composed of one part of sulphite of sodium to one hundred parts of water, to which has been added a one-fifth part of a watery solution of hydrochloric or oxalic acid of a strength of 8 parts to 100. They are stirred up with a stick for a few minutes, until they whiten; if left longer they will become friable. Then they are washed out with water again, and left for some time in running water. The sponges

¹ This article is entitled "The Antiseptic Value of the Topical Remedies used in Ophthalmology, and the Methods of Sterilizing Instruments; Tested Bacteriologically"—and was read before the Section on Ophthalmology and Otology at the Academy of Medicine, October 17, 1887, by Dr. John E. Weeks, and will appear in full in the next number of The Archives of Ophthalmology.

simply with green (or whale oil) soft soap and water, are taken from the jars, where they have been soaking several days in a 1:5000 sublimate solution, and squeezed out in a similar fresh solution placed in glass basins.

In the meanwhile the hand and forearm, after the Esmarch bandage has been put on, have been scrubbed diligently with soft soap and a brush, which attention has already been given by the operator to his own hands, and finally, after this has been done the parts are washed off with 1:1000 sublimate solution, or with alcohol, and in particular cases with both fluids. The operator then dips his hands in the basin containing a 1:1000 sublimate solution, and taking a knife handed him by a similarly prepared assistant, he begins cutting.

Discard for the present the steps peculiar to the amputation, and fasten your attention only on the antiseptic details. During the operation, from time to time, a 1:5000 sublimate solution (for stronger ones prove at times poisonous to the system) is allowed to trickle over the cut surface from a douche bottle, or from a sponge, and this is always thoroughly done before the wound is sutured. All the vessels are tied with catgut, prepared either by immersion for 12 to 48 hours in a watery sublimate solution of 1:1000, or in oil of juniper for 10 days, according to Cavel, and then kept in 95 per cent. alcohol until used. The drainage is effected by rubber or glass tubing, horsehair, or bundles of catgut, of relative value in the order named. These are also kept ready for use in sublimate solutions of the same strength. Neuber's bone drains have fallen into disuse with us; they not only drain poorly at times, but also render infection of the wound possible from their animal structure.¹ The sutures are likewise of catgut, a little heavier than that used for ligatures, and they are introduced with straight Hagedorn needles, which are supplied with a large eye, and admit, therefore, the ready carrying of catgut, and withal they are very sharp, penetrating the skin most readily. I prefer to employ now, and where I specially want primary union, a wrinkle of Kümmel's, though perhaps it is a refinement. I mean the loosely felted spun glass, which, duly sublimated, is laid on the sutured wound, and over this is put the absorbent dressing.

are afterward put into a carbolic acid solution, 1 to 20, or in a solution of 1 to 1000 of the bichloride of mercury, and kept there until used.

Sponges so prepared, such as we use at this hospital, cost but about one cent and a half each; and at that price they may be thrown away after use at an operation. This is my custom in private practice; at the hospital it is the rule that, if the operation is one upon the rectum, the vagina, or other parts where contamination is likely to take place, the sponges used are afterward destroyed; in amputations and other cleanly operations upon the otherwise healthy subject, the sponges are cleansed for subsequent use. In all abdominal operations new sponges are employed. The sponges that are to be again used are washed thoroughly in running water, and afterward kept for some some hours in a weak carbonate of soda solution, to dissolve out the fibrin, etc., and then placed in the antiseptic solution as before.

The simpler plan, advocated by Kümmel, of only washing the sponges with green soft soap and water, and then placing them in a 1 to 20 carbolic solution, or in 1:1000 sublimate solution, has been followed by me for too short a time to speak positively as to its merits.

¹ So much does Kocher, of Berne, object to this influence that he has, according to latest reports, discarded catgut, and now uses only silk, freshly boiled.

Observe the word *absorbent*—we are striving for a dressing that will not only prevent decomposition of the discharges, but one, also, that will promote dryness of the wound; for it has been found that germs require for their increase from fifty to seventy per cent. of moisture. The old Lister dressing, shut in with its rubber or Mackintosh covering, was an error in this respect. Now with the capillarity of my spun glass at work, all discharges are carried into my mass of mussed up sublimated gauze, which has been dusted on the surface next the wound with iodoform, and which is covered with a number of such clumps of gauze, and finally with a thick layer of absorbent (not borated, for this has no value) cotton, and the whole secured by a wet sublimated gauze bandage. If the wound is a large one, or one likely to have much secretion, or one where a redressing is to be postponed for a long time, small bags of sublimated peat (which is preferred by me to most of the other absorbents of like nature, such as wood-wool, moss, etc.) are placed next the wound, first duly dusted with iodoform.

A card has just been sent down to me by one of the students, asking why I do not use iodoform gauze over my wounds. I am glad the question has been put. My omission to use this kind of gauze is intentional. I found, several years since, that the iodoform gauze made then and now with some sticky substance impregnated in it, to hold in its meshes the iodoform, is apt to dam up the secretions from the wound and prevent the same from being freely sucked up by my absorbent material beyond; and though some improvement has been made in the gauze (of which that made from the rather expensive ethereal solutions is the best), yet, I now only use this form of gauze in open wounds, or where I wish to pack cavities, or to arrest hemorrhage by pressure, etc.

Now let me tell you how the sublimated gauze is made. The slight aniline color you see that it has, is given to it simply to distinguish it from the unimpregnated kind. You understand you may, at a pinch, use almost any loosely woven cotton or linen material, mosquito-netting or old napkins for instance. The gauze we have is made specially for the hospital, and is, indeed, nothing but cheese-cloth, which you can render absorbent by boiling in water to which a slight amount of soda is added to remove its greasiness, and then drying. You can also buy it in a better form of Am Ende,¹ who has devoted a good deal of time to the careful making of antiseptic preparations. But remember not to purchase the impregnated gauze, for unless it is carefully kept in a damp condition, and properly wrapped up in an impermeable wrapper such as rubber or gutta-percha tissue, or put in an air-tight glass jar, the bichloride will soon become changed into the comparatively inert calomel. In fact, even in quite freshly made but dry gauze, a large quantity of calomel will soon be found, and this and the remaining bichloride can perceptibly be shaken out of it; also, germs find a lodgement in the dry gauze. This will be alluded to in a few moments. By chemical tests I have found that well-preserved damp gauze had not appreciably changed its strength one month after its manufacture.

The formula for making the sublimate gauze is this: One part of sublimate and two parts of common salt are dissolved in five hundred parts of water; the gauze is soaked in this for an hour, wrung out, and partially dried in a clean room. That is to say, it should not be made or handled in a hospital ward or sick room, and it should be kept in a moist condition in glass jars. The chloride of sodium is intended to prevent the conversion of the sublimate into calomel. Chloride of ammonium will also accomplish this. A small quantity of glycerine is of service in like manner, especially when the gauze is likely to be kept some little time. Here, however, gauze is used so rapidly that this precaution is not followed. This gauze has been made of this increased strength by experience which is supported by the recent tests of Schlange, to be presented in a few moments.

For making iodoform gauze I find the following gives the best results, and it can be made very rapidly, as you will see, for the nurse will make some while I describe the process: 3 drachms of powdered iodoform are mixed up with 6 ounces of ordinary Castile soapsuds, using a 1 to 5000 solution instead of ordinary water; this makes a temporary emulsion, which is poured over 3 parts by weight of absorbent gauze, which is equal to 2½ yards, and evenly distributed through it by a short rubbing process. This will make a 10 per cent. gauze, and the soap will hold the iodoform satisfactorily in the meshes of the gauze. For a 25 per cent. gauze the iodoform needs to be increased to 7 drachms, the other proportions remaining the same.

When we wish to use iodoform in deep cavities, where frequent redressing is not desirable, as, for instance, after extirpation of the rectum or of the tongue, an iodoform gauze of a more adherent nature is often employed. This is prepared by pouring over 5 yards of absorbent gauze a mixture of

Iodoform	.	.	.	.	.	3iiss.
Resin	.	.	.	.	.	3iss.
Alcohol	.	.	.	.	.	3iv.
Glycerin	.	.	.	.	.	3vj.

I have said nothing so far concerning the spray; you will have already noticed that we do not use it often. It is of value, as Cheyne has proven, but irrigation so satisfactorily destroys the germs, that the spray is only now employed where irrigation is impracticable; as, for instance, in certain operations on the brain, or in the large cavities of the chest and abdomen, and in some of the operations on the joints; in all these I frequently use the spray.

Every conscientious surgeon will admit that his use of antiseptics is not always certain in controlling inflammation and suppuration. Theoretically this should be so. The gross errors we have learned, it is true, to avoid. With a well-trained staff of assistants, a surgeon versed in antiseptic work will have a success which may be claimed as a marvellous one; but even with such a person untoward results are likely to happen at any time. These accidents are not always easy of explanation, but the investigations of our German colleagues have shown us in what direction we should carry our researches in explaining these mishaps, which, were it not for the resistance of the tissues to germ influence, would be even more numerous than they are.

Several years ago I was led to point out the errors of the Lister dressing,¹ which from the volatility of the carbolic acid often became unreliable, and by a faulty method of preparing catgut often did damage. Since then Kümmel, of Hamburg, has also taught us how common infection of a wound is by the contact of sponges and instruments used, and by the hands of the surgeon and his assistants. He has, moreover, showed us how to avoid these errors by the procedures enumerated in a preceding page.

A more recent observer, Schlange,² of Berlin, has exposed to us that defects of no mean order are to be met with in our supposed aseptic sublimate dressings. He has proven after examination that all antiseptic bandage materials made by manufacturers contain without exception more or less microorganisms which are capable of liquefying gelatine—*i. e.* producing putrefaction; but that recently prepared moist gauze or gauze that has been rendered sterile by heat or boiling water can be considered free from germs; one might, therefore, consider that our use of the moist sublimate gauze can still be relied upon in spite of its occasionally irritating or blistering the surrounding skin.

The possibility of another error must also be kept in mind. It is that the value of the protection of the sublimate gauze where blood or other secretions are absorbed by it, is much impaired by the conversion of the sublimate into the inert albuminate of mercury. Schlange mixed equal parts of a 1:2000 sublimate solution and blood together and introduced in this mixture different bacterial germs, which rapidly went on to full development ~~unhindered by the sublimate~~. Similar germs introduced into a solution of sublimate of the same strength without the blood admixture were rapidly destroyed. Moreover, as previously spoken of, the drier the wound can be kept the less will be the chance for germs to develop.

All these facts show us the weak points of the sublimate dressing, and the reasons why a recently boiled water and a dressing recently heated to the same degree of temperature offer ideal materials. It is perhaps a little more troublesome to make a dressing in this way than it would be to resort to the easier handled sublimate solutions and dressings, but a little ingenuity, in the possession of all of us, will obviate these difficulties. I shall certainly attempt to overcome them, and hope before the close of the winter to inform you of the value and of the simplest forms of preparing, and, what is more important, keeping the heated dressings.

ORIGINAL ARTICLES.

A CASE OF SUBDIAPHRAGMATIC ABSCESS.³

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The following case came under my observation some months ago, and is of interest because of its comparative rareness.

¹ "The Weak Points in a Lister Dressing," etc. THE MEDICAL NEWS, May 5, 1883.

² Ueber Sterile Verbandstoffe, 1887, xvi. Congr. der deutsch. Gesellsch. für Chir. Berlin.

³ Read before the Montreal Medico-Chirurgical Society, December 9, 1887.